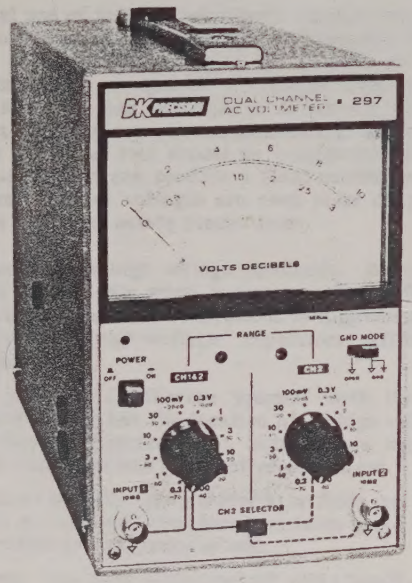
INSTRUCTION MANUAL

B+K PRECISION

295
297



Wide Band AC VOLTMETER

B+K PRECISION DYNASCAN CORPORATION

TEST INSTRUMENT SAFETY

WARNING

Normal use of this test equipment exposes you to a certain amount of danger from electric shock because it is sometimes used to measure high voltages, or is used to make other measurements in equipment containing high voltage. An electric shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a fatal current under certain conditions. Higher voltages are even more dangerous. Observe the following safety precautions:

1. Don't expose high voltage needlessly. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.
2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
3. Use an insulated floor material or floor mat to stand on, and an insulated work bench surface; make certain such surfaces are not damp or wet.
4. Keep "one hand in the pocket" while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
5. Some equipment with a two-wire ac power cord, including some with polarized power plugs, is the "hot chassis" type. This includes most recent television receivers and audio equipment. A plastic or wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result. To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B & K-Precision** Model TR-110 Isolation Transformer, or Model 1653 or 1655 AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.
6. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as on-off switches, fuses, power transformers, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.
7. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

Instruction Manual

for

Model 295-Single Channel

and

Model 297-Dual Channel

WIDE BAND

AC VOLTMETERS

B+K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street
Chicago, Illinois 60635

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LIMITED ONE-YEAR WARRANTY ..... inside back cover

The **B & K-Precision** Wid
and 297, measure ac voltage
Each has 12 full scale ranges
0.3 mV to 100 V for Mode
response permits measurem
acy is within 3% at 1 kHz,
2% from 30 Hz to 100 kHz.
These high sensitivity mete
100 μV for Model 295, or 3
measuring and tracing audio

For versatility and ease
scales, a dB scale (0 dB =
1 mW across 600 Ω). The
making relative measureme
Model 295 has dynamic ran
dBm, while Model 297 has
and -90 to +42 dBm.

The large 4-inch meter
easy to read. The compact
handle for easy portability.

The low distortion amp
provides a 600-ohm output
as a calibrated high gain
brated at 1 volt rms for a f
level is easily read from t
full scale. The preamplifi
to be measured on the me
ciently to drive an oscillos

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INTRODUCTION

The **B & K-Precision** Wideband AC Voltmeters, Models 295 and 297, measure ac voltages over a very wide voltage range. Each has 12 full scale ranges; 1 mV to 300 V for Model 295, or 0.3 mV to 100 V for Model 297. The wideband frequency response permits measurements from 5 Hz to 1 MHz. Accuracy is within 3% at 1 kHz, and frequency response is within 2% from 30 Hz to 100 kHz, within 10% from 5 Hz to 1 MHz. These high sensitivity meters permit measurements down to 100 µV for Model 295, or 30 µV for Model 297; excellent for measuring and tracing audio and rf signal levels.

For versatility and ease of use, the meter has two voltage scales, a dB scale (0 dB = 1 V), and a dBm scale (0 dBm = 1 mW across 600 Ω). The dB and dBm scales are used for making relative measurements (gain, attenuation, etc.). The Model 295 has dynamic ranges of -80 to +50 dB and -80 to +52 dBm, while Model 297 has dynamic ranges of -90 to +40 dB and -90 to +42 dBm.

The large 4-inch meter gives excellent resolution and is easy to read. The compact, rugged instrument has a carrying handle for easy portability.

The low distortion amplifier used to drive the meter also provides a 600-ohm output, allowing the instrument to serve as a calibrated high gain preamplifier. The output is calibrated at 1 volt rms for a full scale meter reading; the output level is easily read from the 1-volt scale for values less than full scale. The preamplifier feature permits low level signals to be measured on the meter, if desired, and amplified sufficiently to drive an oscilloscope or other instruments.

The meter uses absolute mean value (average) sensing, calibrated to read the rms value of a sine wave voltage. The input voltage is capacitively coupled, permitting measurement of an ac signal superimposed on a dc voltage. The 10 Megohm input impedance on all ranges, with low shunting capacitance, assures minimum circuit loading to the equipment under test.

The attenuator is electronically switched with relays and FET switches, providing higher reliability, improved signal-to-noise ratio, and less crosstalk (on dual-channel model) than with the direct rotary switch method. This design also permits remote control of range switching if desired.

The Model 295 is a single-channel version, with a handy RELATIVE REFerence control, which permits the reference value to be set at any convenient level such as 0 on the dB scale. Subsequent readings can then be directly compared to the reference level without calculations. An UNCAL indicator reminds the user to return the control to the CAL position for voltage measurements.

The Model 297 is a dual-channel version, capable of measuring two voltages simultaneously. The meter has dual pointers, black and red, for convenient direct comparison of two levels, such as stereo balance measurements. The two input attenuators can be interlocked to permit a single control to select the range for both channel 1 and 2, or independent ranges may be selected for each channel. Both channels of the Model 297 operate as preamplifiers. The Model 297 also offers switch selectable case ground or floating reference.

FEATURES

WIDEBAND
Measures ac voltages from 5 Hz to 1 MHz.

HIGH SENSITIVITY
Measures voltage as low as 100 μV for Model 295.
Measures voltage as low as 30 μV for Model 297.

WIDE VOLTAGE RANGE
12 ranges from 1 mV to 300 V full scale for Model 295.
12 ranges from 0.3 mV to 100 V full scale for Model 297.

dB SCALE (0 dB = 1 V)
Relative measurements from -80 to +50 dB for Model 295.
Relative measurements from -90 to +40 dB for Model 297.

dBm SCALE (0 dBm = 1 mW across 600 Ω)
Relative measurements from -80 to +52 dBm, Model 295.
Relative measurements from -90 to +42 dBm, Model 297.

LARGE METER
High resolution 4-inch meter is easy to read. Taut-band meter movement is rugged and reliable.

10 MΩ INPUT
10 MΩ input impedance with less than 45 pF shunting capacitance on all ranges assures minimum circuit loading.

AMPLIFIER OUTPUT
Permits use as high gain, low distortion preamplifier.

DUAL POWER SOURCE
Matched positive and negative power sources and differential amplifiers provide very stable dc bias and quickly recover from overload.

SIMPLIFIED ADJUSTMENTS
Number of adjustments are minimized through the use of open loop amplifiers with 1% resistors to establish precision gain via negative feedback.

ELECTRONIC RANGE SWITCHING
Indirect attenuator switching by logic control circuit, FET's and relays provide higher reliability and less noise than direct rotary switch method. Also permits remote control of range switching, and interlocked range selection of dual channels in Model 297.

RUGGED, COMPACT CONSTRUCTION
Steel case; carrying handle for portability.

ADDITIONAL MODEL 295 FEATURES

VARIABLE RELATIVE REFERENCE
Permits reference level to be set to convenient reference such as 0 on dB scale for relative measurements. CAL position for voltage measurements.

UNCAL INDICATOR
Reminds user that meter is uncalibrated for voltage measurements.

ADDITIONAL MODEL 297 FEATURES

DUAL CHANNEL
Two inputs, two outputs, two pointers on meter. Permits direct comparison of two signals such as stereo channels.

SELECTABLE GROUND MODE
Select case ground or floating reference.

MOD

METER SECTION

Measurable Voltage
1 mV to 300 V in
100 mV, 300 mV,
dB
-80 to +50 dB (0
dBm
-80 to + 52 dBm
Error
Less than 3% of
Frequency Respons
±10% at 5 Hz to
±5% at 10 Hz to
±2% at 20 Hz to

Input Impedance
10 MΩ ±5% with
Maximum Input Vo
500 V dc + ac p
100 V dc + ac p
Stability
±0.5% of full
Temperature Coe
±0.08%/° C.
Operating Tempe
0 to +50° C.
Relative Humidit
to 80%.

SPECIFICATIONS

MODEL 295 – SINGLE CHANNEL

METER SECTION

Measurable Voltage
1 mV to 300 V in 12 ranges: 1 mV, 3 mV, 10 mV, 30 mV, 100 mV, 300 mV, 1 V, 3 V, 10 V, 30 V, 100 V, 300 V.

dB
-80 to +50 dB (0 dB = 1 V).

dBm
-80 to + 52 dBm (0 dBm = 1 mW, 600 Ω).

Error
Less than 3% of full scale @ 1 kHz.

Frequency Response (referenced to 1 kHz response)
±10% at 5 Hz to 1 MHz.
±5% at 10 Hz to 500 kHz.
±2% at 20 Hz to 100 kHz.

Input Impedance
10 MΩ ±5% with less than 45 pF parallel capacitance.

Maximum Input Voltage
500 V dc + ac peak; 1 V to 300 V ranges.
100 V dc + ac peak; 1 mV to 300 mV ranges.

Stability
±0.5% of full scale for ±10% line voltage fluctuation.

Temperature Coefficient
±0.08%/° C.

Operating Temperature
0 to +50° C.

Relative Humidity
to 80%.

MODEL 297 – DUAL CHANNEL

METER SECTION (CH 1 and CH 2)

Measurable Voltage
0.3 mV to 100 V in 12 ranges: 0.3 mV, 1 mV, 3 mV, 10 mV, 30 mV, 100 mV, 0.3 V, 1 V, 3 V, 10 V, 30 V, 100 V.

dB
-90 to +40 dB (0 dB = 1 V).

dBm
-90 to + 42 dBm (0 dBm = 1 mW, 600 Ω).

Error
Less than 3% of full scale @ 1 kHz.

Frequency Response (referenced to 1 kHz response)
±10% at 5 Hz to 1 MHz.
±5% at 10 Hz to 500 kHz.
±3% at 20 Hz to 200 kHz.
±2% at 30 Hz to 100 kHz.

Input Impedance
10 MΩ ±5% with less than 45 pF parallel capacitance.

Maximum Input Voltage
500 V dc + ac peak; 1 V to 100 V ranges.
100 V dc + ac peak; 0.3 mV to 0.3 V ranges.

Stability
±0.5% of full scale for ±10% line voltage fluctuation.

Temperature Coefficient
±0.08%/° C.

Operating Temperature
0 to +50° C.

Relative Humidity
to 80%.

MODEL 295 - SINGLE CHANNEL

- - -

- - -

AMPLIFIER SECTION

Gain
60 dB ±1 dB.
Output Voltage
1 V rms ±10% at meter full scale.
Output Impedance
600 Ω ±10%.
Distortion
Less than 1% at full scale (rated by signal-to-noise ratio in 1 mV and 1 V ranges).
Signal-to-Noise Ratio
Over 40 dB at full scale.
Frequency Response
Within ±3 dB from 5 Hz to 500 kHz.

POWER SUPPLY SECTION

Line Voltage
100, 120, 220, or 240 VAC ±10%, 50/60 Hz.
Power Consumption
Below 5 Watts.

MODEL 297 - DUAL CHANNEL

METER SECTION (continued)

Crosstalk
Individual:
Less than -80 db with other input terminated into 600 Ω.
Interlock:
Less than -50 dB with other input terminated into 600 Ω.
Residual Noise:
Less than 30 µV on 0.3 mV range with shorted input.

AMPLIFIER SECTION (CH 1 and CH 2)

Gain
Approx. 70 dB.
Output Voltage
1 V rms ±10% at meter full scale.
Output Impedance
600 Ω ±10%.
Distortion
Less than 1% at full scale (rated by signal-to-noise ratio in 0.3 mV, 1 mV and 1 V ranges).
Signal-to-Noise Ratio
Over 40 dB at full scale (over 30 dB for 0.3 mV range).
Frequency Response
Within ±3 dB from 5 Hz to 500 kHz.

POWER SUPPLY SECTION

Line Voltage
100, 120, 220, or 240 VAC ±10%, 50/60 Hz.
Power Consumption
Approx. 7 Watts.

MODEL 295 – SINGLE CHANNEL

MISCELLANEOUS

Dimensions (HWD)
7-1/2 x 5 x 9-3/8" (190 x 128 x 238 mm).
8-3/8 x 5 x 10-1/4" (212 x 130 x 260 mm) including protrusions.

Weight
6 lb (2.7 kg).

ACCESSORIES SUPPLIED

Detachable AC Power Cord.
Input Cable.
Spare Fuse.
Instruction Manual.
Schematic Diagram & Parts List.

MODEL 297 – DUAL CHANNEL

MISCELLANEOUS

Dimensions (HWD)
7-1/2 x 5 x 9-3/8" (190 x 128 x 238 mm).
8-3/8 x 5 x 10-1/4" (212 x 130 x 260 mm) including protrusions.

Weight
7 lb (3.2 kg).

ACCESSORIES SUPPLIED

Detachable AC Power Cord.
Two Input Cables.
Spare Fuse.
Instruction Manual.
Schematic Diagram & Parts List.

MODEL 295 - SINGLE CHANNEL

FRONT PANEL
Refer to Fig. 1.

1. **Pilot Light.** Lights when unit is on.
2. **POWER ON-OFF Switch.**
3. **RANGE Switch.** Twelve-position rotary switch attenuator selects full scale sensitivity of meter.
4. **INPUT Jack.** Connector for input signal to be measured. Outer conductor is common with instrument case (and earth ground via power cord).
5. **OUTPUT Jack.** Provides amplified, buffered sample of signal being measured on meter. Output level is 1 V rms for full scale meter reading. Outer conductor is common with outer conductor of INPUT jack.
6. **RELATIVE REF Control.** For relative measurements (dB, gain, loss, etc.), adjusts reference level to some convenient value, such as 0 dB. Full clockwise position is CAL, which must be used for voltage measurements.
7. **UNCAL Indicator.** Lights to remind user that RELATIVE REF control is not set to CAL position.
8. **Meter.** Indicates value of voltage being measured. Has two voltage scales, dB scale, and dBm scale.

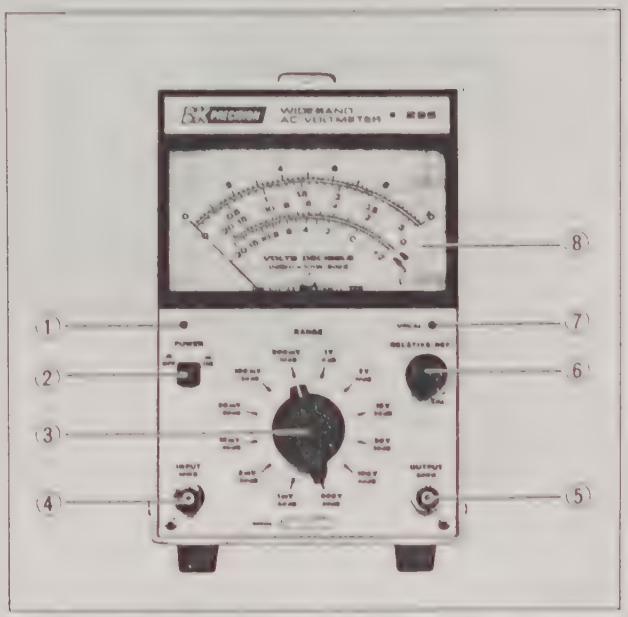

Fig. 1. Front Panel Controls, Model 295.

MODEL

FRONT PANEL
Refer to Fig. 2.

1. **Pilot Light.** Light
2. **POWER ON-OFF**
3. **CH 1 & 2 RANGE** attenuator select lects meter rang SELECTOR swit meter range for switch set to Inde
4. **INPUT 1 Jack.** be measured.
5. **CH 2 SELECTOR** erates as follows **Interlock Def** simultaneously s inputs. **Independent** ate independent range for chann lects range for
6. **INPUT 2 Jack.** be measured.
7. **CH 2 RANGE S** tor switch. S CH 2 SELECTO

MODEL 297 - DUAL CHANNEL

FRONT PANEL.
Refer to Fig. 2.

1. **Pilot Light.** Lights when unit is on.
2. **POWER ON-OFF Switch.**
3. **CH 1 & 2 RANGE Switch.** Twelve-position rotary switch attenuator selects full scale sensitivity of meter. Selects meter range for both channel 1 and 2 with CH 2 SELECTOR switch set to Interlock (left), or selects meter range for channel 1 only with CH 2 SELECTOR switch set to Independent (right).
4. **INPUT 1 Jack.** Connector for channel 1 input signal to be measured.
5. **CH 2 SELECTOR Switch.** Two-position slide switch operates as follows:
   Interlock (left) Position: CH 1 & 2 RANGE switch simultaneously selects meter range for channel 1 and 2 inputs.
   Independent (right) Position: RANGE switches operate independently. CH 1 RANGE switch selects meter range for channel 1 input, and CH 2 RANGE switch selects range for channel 2 input.
6. **INPUT 2 Jack.** Connector for channel 2 input signal to be measured.
7. **CH 2 RANGE Switch.** Twelve-position rotary attenuator switch. Selects meter range for channel 2 with CH 2 SELECTOR switch set to Independent (right).

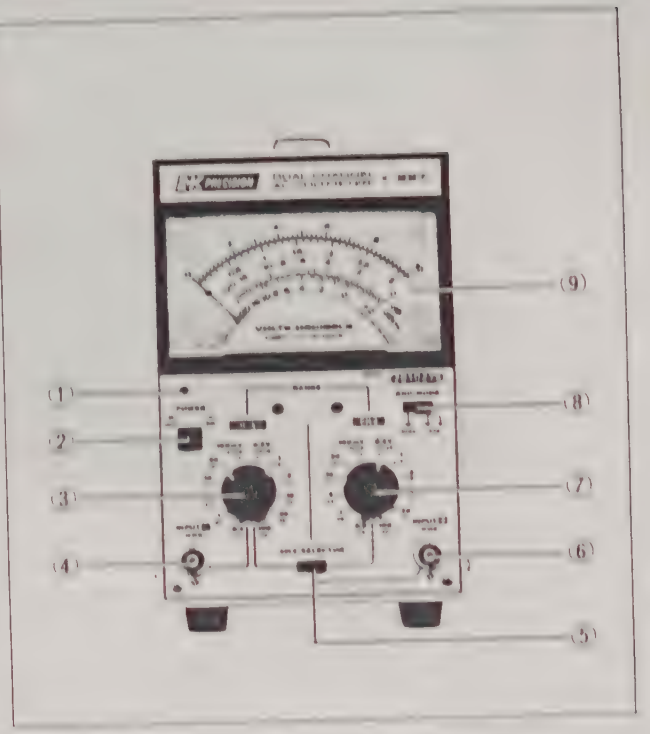

Fig. 2. Front Panel Controls, Model 297.

MODEL 297 - DUAL CHANNEL

FRONT PANEL (Continued)

8. **GND MODE Switch.** Two position slide switch operates as follows:
   OPEN Position: Isolates outer conductor of CH 1 and CH 2 INPUT jacks from instrument case for floating reference.
   GND Position: Connects outer conductor of CH 1 and CH 2 INPUT jacks to instrument case (and earth ground via power cord).
9. **Meter.** Indicates values of voltages being measured. Has two voltage scales, dB scale, and dBm scale. Meter has dual pointers to permit simultaneous measurement of two inputs; black pointer for channel 1 and red pointer for channel 2.

MODEL 295 - SINGLE CHANNEL

REAR PANEL
Refer to Fig. 3.

9. **Fuse.** Use 0.2 A for 100 or 120 VAC, 0.1 A for 220 or 240 VAC.
10. **Power Cord Receptacle.**
11. **Line Voltage Selector.** Removable plug may be inserted four ways to select 100, 117, 220, or 240 V line voltage.
12. **Access Plate.** Connector may be installed under access plate for remote control per Appendix I.

MODEL 297 - DUAL CHANNEL

REAR PANEL
Refer to Fig. 4.

10. **Ground Terminal.** Instrument case ground (and earth ground via power cable). Should be used to ground chassis of equipment under test during floating reference measurements.
11. **CH 2 OUTPUT Jack.** Provides amplified, buffered sample of channel 2 signal being measured on meter. Output level is 1 V rms for full scale meter reading. Outer conductor of CH 2 OUTPUT jack is common with outer conductor of the INPUT 2 jack.
12. **Line Voltage Selector.** Removable plug may be inserted four ways to select 100, 117, 220, or 240 V line voltage.
13. **Power Cord Receptacle.**
14. **Fuse.** Use 0.5 A for 100 or 120 VAC, 0.3 A for 220 or 240 VAC.
15. **CH 1 OUTPUT Jack.** Provides amplified, buffered sample of channel 1 signal being measured on meter. Output level is 1 V rms for full scale meter reading. Outer conductor of CH 1 OUTPUT jack is common with outer conductor of the INPUT 1 jack.
16. **Access Plate.** Connector may be installed under access plate for remote control per Appendix I.

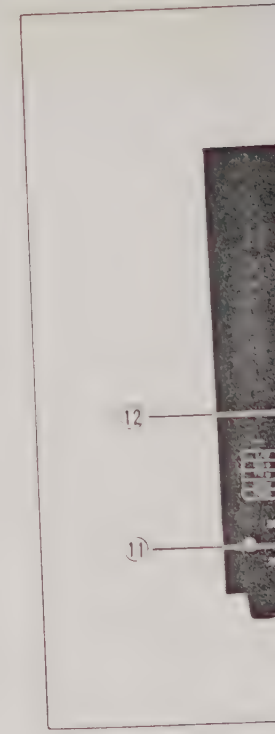

Fig. 3. Rea

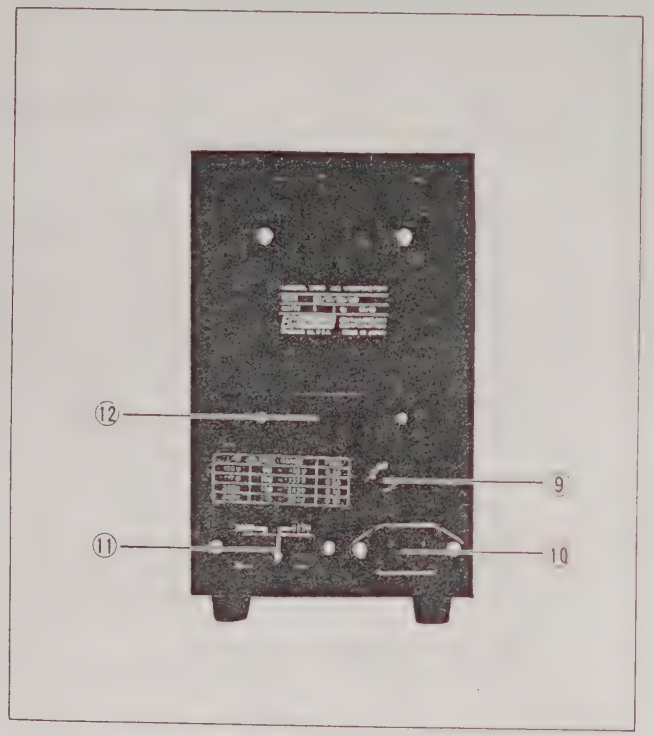

Fig. 3. Rear Panel Controls, Model 295.

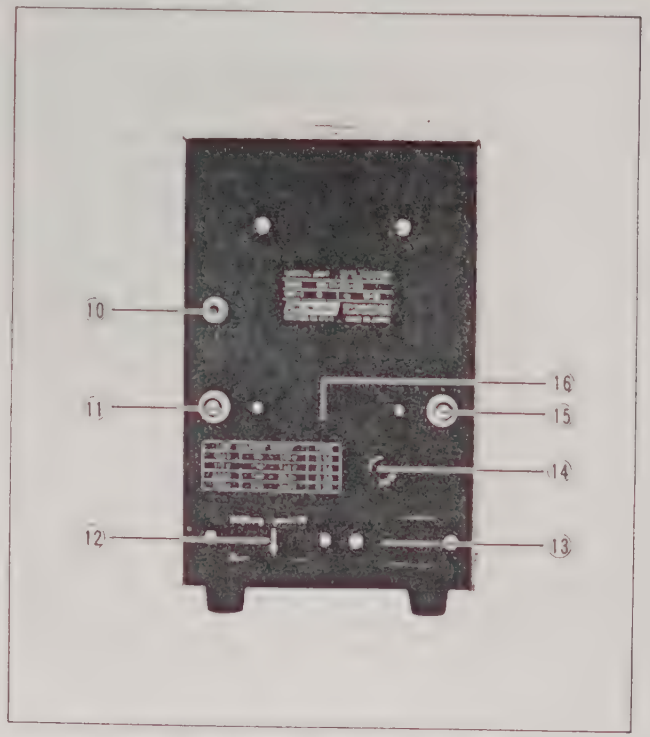

Fig. 4. Rear Panel Controls, Model 297.

SAFETY PRECAUTIONS

WARNING

The following precautions must be observed to prevent electric shock.

1. When this ac voltmeter is used to make measurements in equipment that contains high voltage, there is always a certain amount of danger from electrical shock. The person using the ac voltmeter in such conditions should be a qualified electronics technician or otherwise trained and qualified to work in such cirmcumstances. Observe the TEST INSTRUMENT SAFETY recommendations listed on the inside front cover of this manual.
2. Read and observe the recommendations listed in the GROUNDING paragraph in this section of the manual.
3. Do not operate this ac voltmeter with the case removed unless you are a qualified instrument service technician. High voltage is present when the unit is operating with the case removed.
4. The ground wire of the 3-wire ac power plug places the chassis and housing of the ac voltmeter at earth ground. Use only a 3-wire outlet, and do not attempt to defeat the ground wire connection to float the instrument.
5. Special precautions are required to measure ac line voltage with an ac voltmeter.
   a. Since the highest voltage range of Model 297 is 100 volts rms full scale, it is not suitable for measuring ac line voltage.
   b. To measure ac line voltage with Model 295, use the 300 V range.
   c. Do not connect the black ground clip of the input cable to either side of the ac line. The clip is always at earth ground on Model 295. Touching the ground clip to the hot side of the ac line may "weld" or "disintegrate" the ground clip and cause possible injury, plus possible damage to the ac voltmeter.
   d. Connect the red clip to one side of the ac line, then the other. One side of the ac line should be "hot" and produce a voltage reading. The other side should be ground return and produce no significant voltage reading on the 300 V range. It is best to avoid measurement of noise on an ac power line, as the meter is very sensitive and noise values may be very high and sporadic.

The following precauti
voltmeter.

1. Excessive voltage
   damage the ac volti
   of the inputs are as
   -70 dB to -10 dB
   70 volts rms; 1
   0 dB to +50 dB re
   350 volts rms;
   Never apply exte
2. The Line Voltage S
   line voltage being
   dependent upon the
   tions in the LINE
   this section of the
3. Read and observe
   GROUNDING para

OPERATING TIPS

The following recom
performance from your

1. Use the input cat
   other cables are
   tance shielded c

EQUIPMENT PROTECTION PRECAUTIONS

CAUTION

The following precautions will help avoid damage to the ac voltmeter.

1. Excessive voltage applied to the INPUT jack(s) may damage the ac voltmeter. The maximum rating ratings of the inputs are as follows:

   -70 dB to -10 dB ranges:
   70 volts rms; 100 volts dc + ac peak.

   0 dB to +50 dB ranges:
   350 volts rms; 500 volts dc + ac peak.

   Never apply external voltage to OUTPUT jacks.

2. The Line Voltage Selector must be set to match the ac line voltage being used. The correct fuse value is also dependent upon the ac line voltage. Follow the instructions in the LINE VOLTAGE SELECTION paragraph in this section of the manual.

3. Read and observe the recommendations listed in the GROUNDING paragraph in this section of the manual.

OPERATING TIPS

The following recommendations will help obtain the best performance from your ac voltmeter.

1. Use the input cables supplied with the voltmeter, or if other cables are used, use coaxial cable or low capacitance shielded cables. Radiated noise and rf energy may interfere with meter readings unless the input cable is well shielded, especially on lower ranges.

2. For measurements at higher than audio frequencies, terminate the input signals into 50 Ω or 600 Ω resistance.

3. Avoid the following operating conditions when possible:

   a. High temperature and high humidity.

   b. Mechanical vibration.

   c. Electrical noise and strong magnetic fields, such as near large motors, power supplies, transformers, etc.

4. The ac voltmeter is ready to use immediately after being switched on, but a five-minute warm-up will give slightly better accuracy and stability.

5. Read and observe the recommendations listed in the GROUNDING paragraph in this section of the manual.

LINE VOLTAGE SELECTION

Before connecting the instrument to ac power the first time, check the line voltage selector on the rear panel. Make sure it is set for the line voltage you are using; 100, 117, 220, or 240 VAC, 50/60 Hz. Also make sure the correct value fuse is installed as follows:

Model 295 - Single Channel Wideband AC Voltmeter:
Use 0.2 A for 100 or 120 VAC line voltage.
Use 0.1 A for 220 or 240 VAC line voltage.

Model 297 - Dual Channel Wideband AC Voltmeter:
Use 0.5 A for 100 or 120 VAC line voltage.
Use 0.3 A for 220 or 240 VAC line voltage.

GROUNDING

Model 295 - Single Channel AC Voltmeter

The outer conductor of the INPUT jack is common with case ground, which is also returned to earth ground through the third wire of the power cord. Connect the black clip of the input cable only to the chassis or a zero voltage point in the equipment under test. Although the outer conductor of the OUTPUT jack is insulated from the case at the OUTPUT jack itself, it is internally common with the outer conductor of the INPUT jack. Thus, the OUTPUT jack common is also at case and earth ground.

CAUTION

Do not attempt to float the reference to a voltage point in the equipment under test; to do so may damage the instrument or the equipment under test.

Model 297 - Dual Channel AC Voltmeter

The GND MODE switch offers a choice of case ground or floating reference. When the GND MODE switch is in the GND position, the outer conductors of the INPUT 1 and INPUT 2 jacks (black clips of input cables) are common with case ground and returned to earth ground through the third wire of the power cord.

When the GND MODE switch is set to the OPEN position, the outer conductors of the INPUT 1 and INPUT 2 jacks are isolated from case ground and may be floated to a voltage point in the equipment under test, or may be isolated from case ground for minimizing the effects of ac hum.

Regardless of the GND MODE selected, the outer conductor of the CH 1 OUTPUT jack is always common with the INPUT 1 jack, and the outer conductor of the CH 2 OUTPUT jack is always common with the INPUT 2 jack.

WARNING

Do not attempt to float the reference to a voltage point when the GND MODE switch is in the GND position. To do so may damage the instrument or the equipment under test. The OPEN position is primarily intended for isolation from case ground to lessen the effects of ac hum in measurements, rather than for floating the reference to a voltage point. Always use care if the reference is floated to a voltage point with the GND MODE switch in the OPEN position, and never exceed 500 volts with respect to earth ground. Electrical shock and damage to the instrument or equipment under test may result.

PREPARATION FOR MEASUREMENTS

1. Press the POWER switch. The pilot light indicator should light.
2. Set the RANGE switch(es) to the highest range. If the value of the voltage to be measured is known, an appropriate range may be selected. If measuring ac voltage that is superimposed on a dc voltage, set the RANGE switch(es) to the highest range so that the initial dc surge does not damage the meter.
3. Model 295 only - Set the RELATIVE REF control to CAL. The UNCAL indicator light should be off.

4. Model 297 only - Se
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VOLTAGE MEASUREM

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dB MEASUREMENTS

Usually, the dB s
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4. Model 297 only - Set the GND MODE switch to the GND position (instructions for floating reference measurements are given in the OPERATING TIPS paragraph).
5. Connect the input cable(s) to the INPUT jack(s). Use the coaxial input cable(s) supplied for shielding against radiated noise and rf energy which may affect measurements, especially at low signal levels.
6. Connect the black clip (outer conductor) of the input cable to the chassis of the equipment under test, or preferably to a chassis reference point near the point of signal measurement.
7. Connect the red clip (inner conductor) of the input cable to the point of voltage measurement.
8. Reduce the RANGE setting for the highest obtainable meter reading without going off scale.
9. Read the meter.

VOLTAGE MEASUREMENTS (Refer to Fig. 5)

There are two voltage scales, 0-to-10 and 0-to-3. Use the 0-to-10 scale for the 1 mV, 10 mV, 100 mV, 1 V, 10 V, and 100 V ranges. A reading of 5 on the 0-to-10 scale, for example, represents 0.5 V when the 1 V range is selected. Similarly, use the 0-to-3 scale for the 0.3 mV, 3 mV, 30 mV, 300 mV, 3 V, 30 V, and 300 V ranges. A reading of 2 on the 0-to-3 scale, for example, represents 20 mV when the 30 mV range is selected.

dB MEASUREMENTS (Refer to Fig. 5)

Usually, the dB scale is used for relative measurements, such as gain of an amplifier, or attenuation at various frequencies across a bandpass filter. For example, -3 dB is a point of half power relative to the reference, -6 dB is a point of half voltage (one quarter power), +3 dB is a point of double power, and +6 dB is a point of double voltage (x4 power). The progression continues logarithmically; 10 dB represents a 10:1 power ratio relative to the reference, 20 dB is 100:1, 30 dB is 1000:1, etc. In such measurements, the first measurement is for reference and subsequent measurements are compared to the reference value. The difference between the two values, in dB, is the desired measurement. For example, let us assume that the input to an amplifier is measured and found to be -24 dB; this is our reference value. The output is then measured and found to be +6 dB. The gain of the amplifier is the difference between the two readings, or 30 dB.

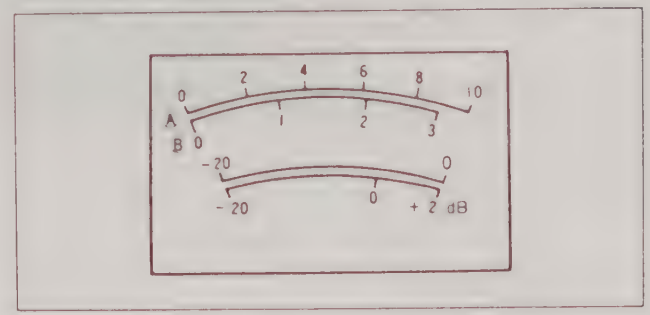

Fig. 5. Meter Scales.

Use the red dB scale of the meter and the red dB steps of the RANGE switch for dB measurements. The dB scale of the meter is calibrated to read from -20 to 0 dB. Each step of

the RANGE switch adds or subtracts another 10 dB attenuation. Use the algebraic sum of the RANGE switch setting plus the meter reading for the total value in dB. For example, a meter reading of -6 dB on the -20 dB range represents a level of -26 dB. A meter reading of -4 dB on the +40 dB range represents a level of +36 dB.

Generally, dB values are expressed in dBV, wherein 0 dB = 1V. Note that on this meter, the 0 dB value corresponds to a 1 V value on the voltage scale.

For dB measurements, the reference measurement and other measurements should be taken across equal impedances for direct comparison. However, a correction factor can be calculated from the graph in Fig. 6 if the input and output impedances are unequal. Plot the reference impedance and the other impedance on the graph, and note the correction factor for each in respect to 600 ohms. Next, subtract the two correction factors. See the example with Fig. 6.

In audio, changes in level of less than 3 dB are not audible to the human ear.

dBm MEASUREMENTS (Refer to Fig. 5)

Audio levels in standard 600-ohm telephone circuits and signal levels in many other applications are expressed in dBm. This is a relative level wherein the reference level of 0 dBm equals 1 mW across 600 ohms (0.775 V). Note that 0 on the dBm scale equals 0.775 on the voltage scale of this meter.

Use the red dBm scale of the meter and the red dB steps of the RANGE switch for dBm measurements. The dBm scale of the meter is calibrated to read from -20 to +2 dBm. Each step of the RANGE switch adds or subtracts another 10 dB attenuation. Use the algebraic sum of the RANGE switch setting plus the meter reading for the total value in dBm. For example, a meter reading of +2 dBm on the -50 dB range represents a level of -48 dBm. A meter reading of -6 dBm on the +30 dB range represents a level of +24 dBm.

Measurements made across 600-ohm impedances may be read directly in dBm. Measurements made across other impedances should have a correction factor added or subtracted as shown in Fig. 6.

USE OF RELATIVE REF CONTROL (Model 295 Only)

The RELATIVE REF control is a convenience in making dB measurements with the Model 295.

1. Initially set the RELATIVE REF control to the CAL position (fully clockwise).
2. Measure the reference level, selecting a range that will provide the highest meter reading without going off scale.
3. With the reference signal still applied, adjust the RELATIVE REF control for the most convenient reference level, such as 0 on the dB scale. It may be necessary to select the next lower range; in which case the meter may go off scale, but can be adjusted back to 0 dB with the RELATIVE REF control. Do not readjust the RELATIVE REF control after this step. The meter reading plus RANGE switch setting now becomes the reference level. For example, with a meter reading of 0 dB and a RANGE switch setting of -30 dB, the reference level becomes -30 dB. This is much more convenient than a reference level such as -24.6 dB.
4. Take measurements at other points and subtract the reference level from the measured value. For example,

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Calculation of Correction Factor for Relative Measurements (dB) Across Non-Equal Impedances

For example, the gain of an amplifier is measured and meter readings show an apparent gain of 20 dB. However, the input impedance of the amplifier is 1 kΩ, and the output impedance is 50 Ω. Using Fig. 6, the reference impedance of 1 kΩ has a correction factor of -2 dB, and the other impedance of 50 Ω has a correction factor of +11 dB. Subtracting -2 dB and +11 dB, we find 13 dB difference. When the reference impedance is higher than the other impedance, use a positive correction factor (+13 dB). When the reference impedance is lower than the other impedance, use a negative correction factor (-13 dB). Thus, in this example, a correction factor of +13 dB should be added to the measured gain of 20 dB. The total power gain in this case is 33 dB.

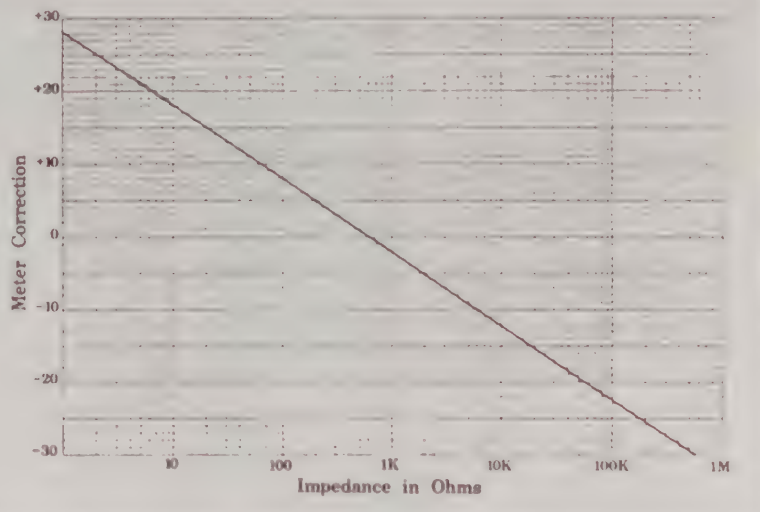

Fig. 6. dBm Correction Factor for Impedances Other Than 600 Ω

a reference level of -30 dB subtracted from a reading of +16 dB equals a relative level of +46 dB with respect to the reference level.

5. The UNCAL indicator lights when the RELATIVE REF control is not set to CAL. Return the control to the CAL position before starting voltage, dBm, or dBV measurements.

USE OF OUTPUT JACKS

The ac voltmeter may be used as a general purpose preamplifier. The input signal(s) being measured on the meter is also available at the OUTPUT jack(s). The unit thus offers high gain and low distortion over the 5 Hz to 1 MHz frequency band. It provides up to 60 dB gain (70 dB for Model 297), with selectable 10 dB steps and a calibrated output level of

1 volt rms at full scale meter reading (into 600 Ω). The output may be used to drive an oscilloscope or other instrument, or in any application where a preamplifier is needed.

Connect a coaxial cable from the OUTPUT jack to the device being driven. Terminate the output into 600 ohms; the output level is not calibrated at other impedances. When terminated into 600 ohms, a full scale meter reading (10 on the voltage scale) represents 1 volt rms. The 0-to-10 scale represents a 0-to-1 volt scale for output levels less than full scale.

DUAL CHANNEL OPERATION (Model 297 Only)

The Model 297 Dual Channel Wideband AC Voltmeter can measure two inputs simultaneously. The meter has dual pointers, red and black, one for each channel. The channel 1 input is read on the black pointer and the channel 2 input is read on the red pointer. Comparison between levels, such as stereo channels, is easier on a dual pointer meter than on two separate meters. Each channel offers an OUTPUT jack, thus the instrument serves as a dual channel (stereo) preamplifier.

The RANGE switches for channel 1 and 2 may be operated independently or interlocked. When the CH 2 SELECTOR switch is set to Independent (right), the CH 2 RANGE selector is enabled and independently selects the range for channel 2. This mode is convenient when the voltage levels of the two channels are different, such as the input and output of an amplifier when performing a gain measurement.

When the CH 2 SELECTOR switch is set to Interlock (left), the CH 2 RANGE selector is disabled. Range selection for channel 1 and 2 is interlocked and both are simultaneously set by the CH 1 & 2 RANGE selector. This is convenient when the voltage levels of both channels are approximately equal, such as comparison of frequency response for stereo channels.

REMOTE CONTROL

Range selection of the Model 295 or 297 Wideband AC Voltmeters may be remotely controlled if desired. The unit must be modified as shown in Appendix I. If so modified, the range selector switch(es) are duplicated on the remote control box. A PANEL-REMOTE switch selects the location from which range selection is enabled.

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BASIC APPLICATIONS

The basic application of this instrument is to measure sinusoidal wave voltages as an ac voltmeter. The wideband frequency response, high sensitivity, and wide voltage range make the instrument well suited for measuring audio and rf signal levels in the 5 Hz to 1 MHz band. Signal tracing and troubleshooting are among the primary applications.

Measurement of frequency response is also a common application. Connect the ac voltmeter to read the output level of the circuit under test. Apply a constant amplitude input signal and vary the frequency. Usually, the output level should remain constant, or at least within ±3 dB, over the frequency range of interest.

Several other applications follow.

AMPLIFIER GAIN MEASUREMENT

Refer to Fig. 7. Measure the signal level in dB at point A and point B. Gain equals B - A in dB. Voltage gain measurements are often made without regard to input and output impedances. A true power gain measurement requires that the correction factor of Fig. 6 be included if the impedances are unequal.

Also, this method is applicable to negative-feedback amplifiers; i.e., the open loop gain of an amplifier may be measured with the negative feedback signals still applied (refer to Fig. 8).

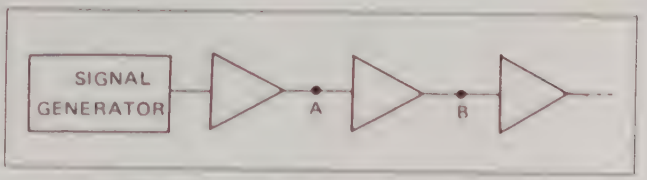

Fig. 7. Amplifier Gain Measurement.

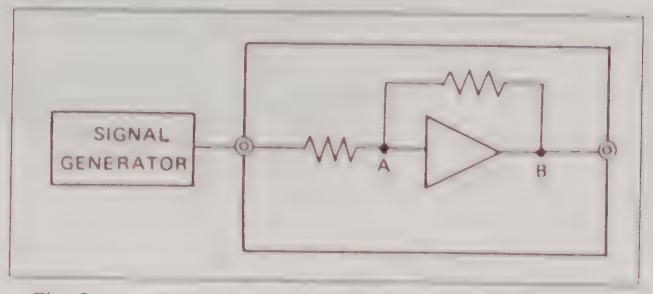

Fig. 8. Negative-Feedback Amplifier Gain Measurement.

Furthermore, frequency response can be measured by changing the signal generator frequency.

As an example, let us calculate the open loop gain from point A to point B of the negative-feedback amplifier shown in Fig. 8. Assume that the measured level at point A is

-1.5 dB on the -60 dB range, and that the measured level at point B is -4 dB on the +20 dB range. The gain from point A to point B is:

$$(+20\ \text{dB} - 4\ \text{dB}) - (-60\ \text{dB} - 1.5\ \text{dB}) = 77.5\ \text{dB}$$

DUAL-CHANNEL VOLTMETER APPLICATIONS

Direct Comparison

Two input channels applied to a dual pointer meter are more useful for direct comparison measurements than two separate voltmeters. An excellent example is measurement of left and right channel characteristics of stereo equipment.

Stereo Frequency Response

Connect the audio generator and dual-channel ac voltmeter as shown in Fig. 9 and apply equal audio signal to the left and right channel inputs of the stereo amplifier. Set the CH 2 SELECTOR switch to the Interlock position and select the desired range with the CH 1 & 2 RANGE selector. Set the GND MODE switch for no adverse effect of hum; usually to GND unless the stereo amplifier has no connection common to the left and right channels; in this case set the switch to OPEN. As the frequency of the audio generator is varied, any differences in frequency response between left and right channels is indicated by unequal deflection of the two meter pointers.

Stereo Crosstalk Measurement

Connect the audio generator and dual-channel ac voltmeter to the stero amplifier under test as shown in Fig. 10,

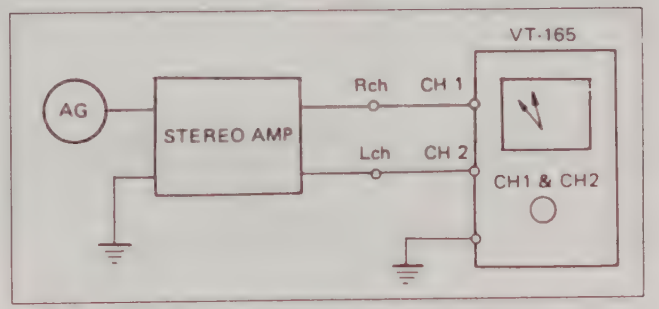

Fig. 9. Stereo Amplifier Frequency Response Measurement.

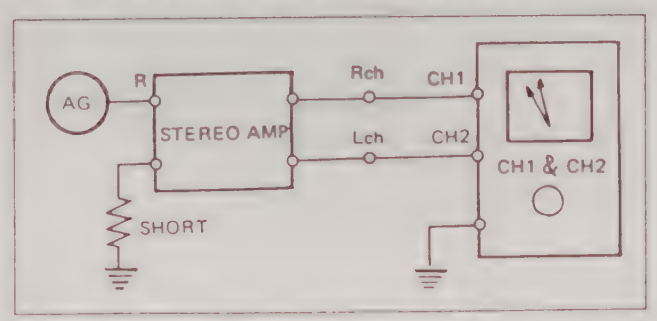

Fig. 10. Stereo Amplifier Crosstalk Measurement.

applying the audio signal to one channel and shorting the input to the other channel. For this measurement, there should be a large difference between the signal levels meas-

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NON-SINUSOIDAL WAVEFORMS

This voltmeter uses an absolute mean value (average value) detector, calibrated to read the rms value of a sine wave voltage. If the form factor (average/rms) of the input wave and the crest factor (peak/rms) are known, then the rms and peak values of other waveforms can be calculated.

The form factor times the rms value equals the average value, and the crest factor times the rms value equals the peak value. The form factor for a sine wave is 0.9 (V is the value indicated on the meter):

$$\frac{2\sqrt{2}}{\pi} \text{ V} = 0.9 \text{ V}$$

Thus, an average value of 0.9 V will produce a 1 V reading on the meter since it is calibrated to read the rms value of a sine wave.

The crest factor for a sine wave is $\sqrt{2}$ V or 1.414 V, thus the peak value is 1.414 times the value indicated on the meter.

For square waves, the form factor and crest factor are unity (1); i.e., the average value and peak value are equal to the rms value. However, since the meter is calibrated for a form factor of 0.9, the meter reads 10% high. The average value, rms value, and peak value of a square wave are 0.9 times the meter reading. The peak-to-peak value, of course, is 1.8 times the meter indication.

For sawtooth waves, the form factor is $2/\sqrt{3}$ and the crest factor is $\sqrt{3}$. In this case, the rms value is 1.04 times the value indicated on the meter, and the peak value is 1.8 times the value indicated on the meter.

BLOCK DIAGRAM ANALYSIS

Refer to block diagrams, Fig. 11 and 12. Except where otherwise noted, the following description applies equally to Single-Channel Model 295 and Dual-Channel Model 297. There are two identical circuits used in the dual-channel version. Electrically, there are two separate meters in the Model 297, but they are mechanically mounted on the same axis, and over the same meter scale to operate as a dual pointer meter.

The ac voltage to be measured is applied to the INPUT connector. Any dc component is blocked by capacitive coupling in the input. The ac component passes through the first attenuator, then through an impedance converter where it is converted to a low impedance. The impedance converted ac voltage is normalized in proportion to 1 volt rms full scale through the second and third attenuator sections. The normalized voltage is amplified by a gain of 20 in the main amplifier and fed to two circuits; the absolute mean value detector and the output amplifier.

The absolute mean value detector converts the ac voltage being measured to dc current that is proportional to the average value of the signal, except that gain is corrected to correspond to the rms value of a sine wave. This dc current drives the meter pointer.

The output amplifier has a low impedance 600 Ω output and a gain of 50 to feed the OUTPUT connector with a 1 volt rms voltage (into 600 Ω) at full scale meter deflection.

Negative feedback and differential amplifier techniques throughout the ac signal circuits assure low distortion, and frequency compensation is used throughout the unit to maintain the wideband frequency response.

The attenuator control circuit encodes the range select data from the RANGE switch and generates control signals to operate the first, second, and third attenuators.

The power supply section feeds ±5 volts dc to the functional circuits, stabilized by IC regulators.

For Model 295 only, the relative reference control circuit permits the output of the main amplifier to be attenuated before application to the absolute mean value detector, for variable meter sensitivity between steps.

For Model 297 only, the CH 2 SELECTOR switch permits either the CH 1 & 2 RANGE selector or the CH 2 RANGE selector to operate the channel 2 attenuator control circuit. Also, the GND MODE switch permits GND or OPEN (floating) reference to the INPUT connector.

SCHEMATIC DIAGRAM ANALYSIS

Refer to the separately supplied schematic diagram.

First Attenuator

This circuit is a resistance type voltage divider switched in two steps of 0 dB (1:1 voltage ratio) or -60 dB (1000:1 voltage

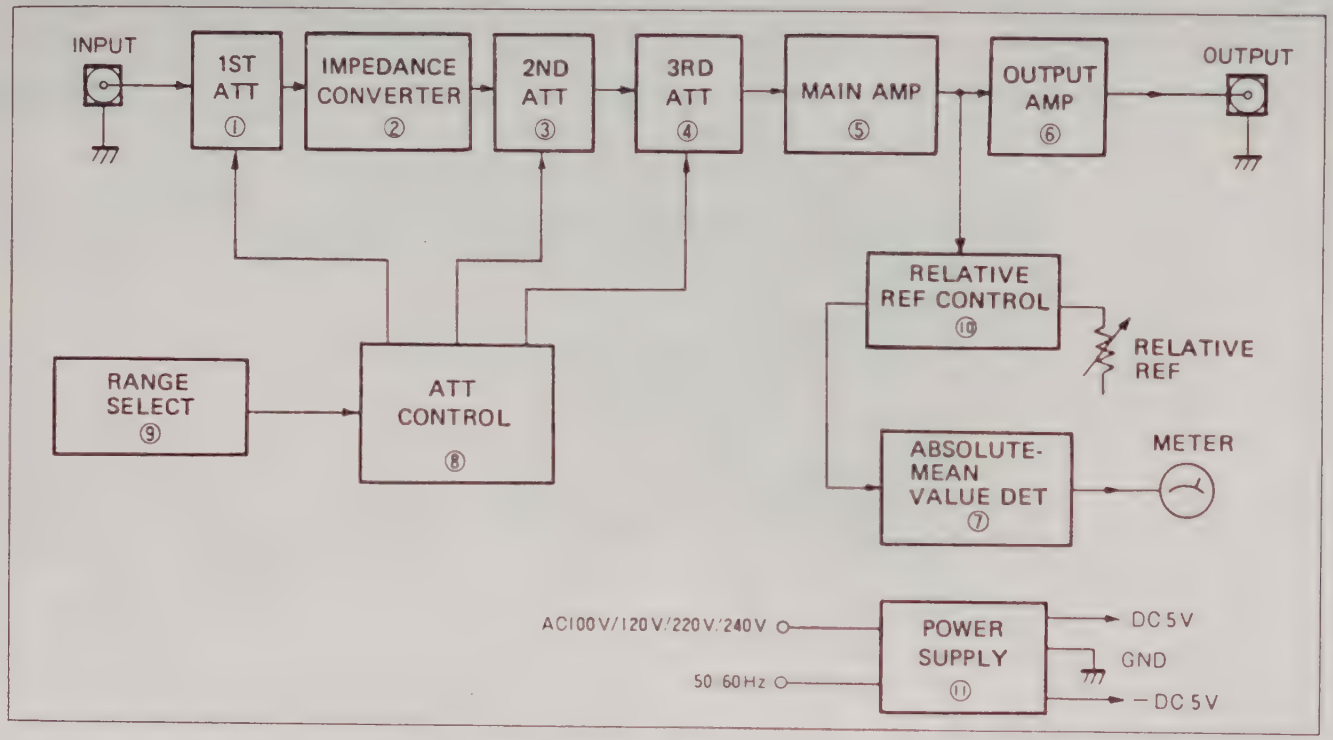

Fig. 11. Block Diagram, Single-Channel Model 295.

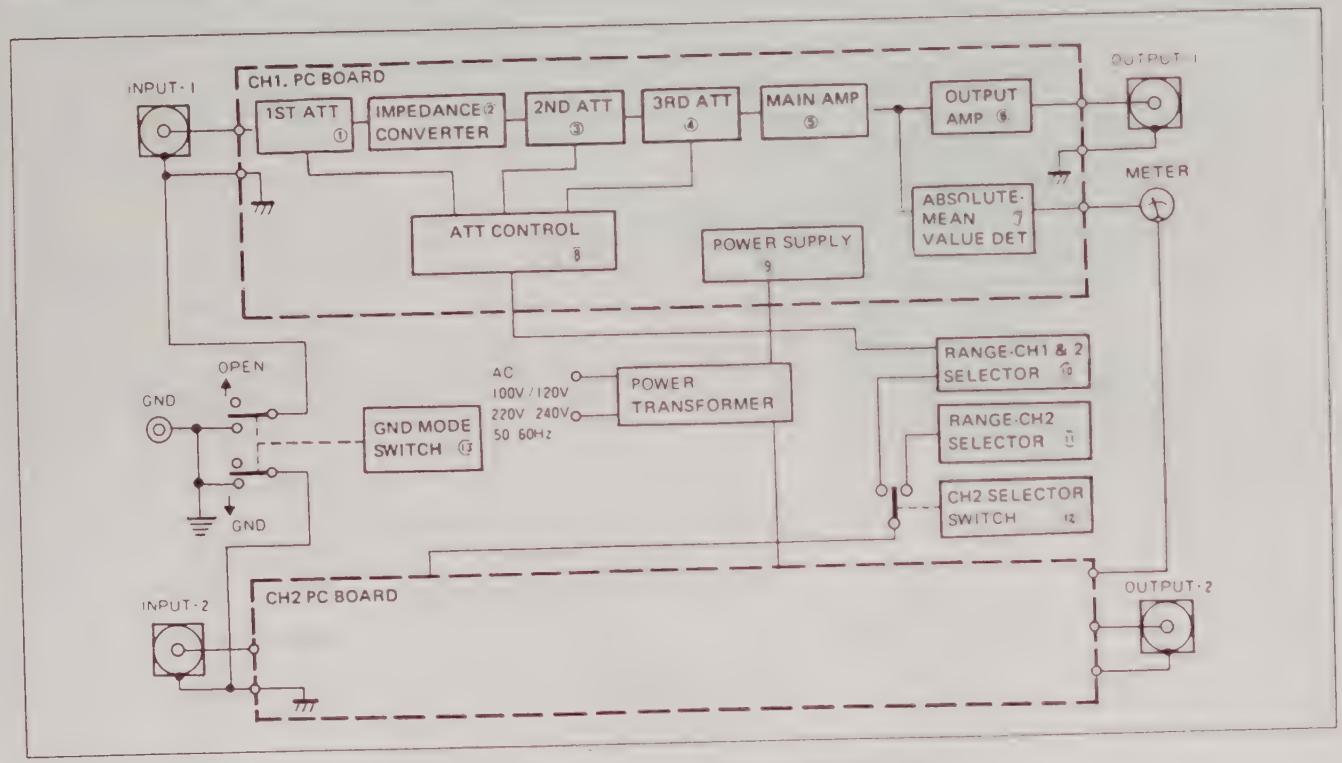

Fig. 12. Block Diagram, Dual-Channel Model 297.

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Main Amplifier

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Output Amplifier

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ratio) by relay contacts. It presents a 10 MΩ input resistance in both steps.

Impedance Converter

This circuit is a non-inverting amplifier with a gain of three and having an FET differential input. It converts the high impedance output of the first attenuator to a low impedance for driving the second and third attenuators.

Second Attenuator

This circuit is also a two-step resistance type voltage divider switched by relay contacts. The two steps of attenuation provided by this attenuator are 0 dB and -30 dB.

Third Attenuator

This circuit is a resistance type voltage divider switched in four steps by an IC containing four FET switches. The four steps are 0 dB, -10 dB, -20 dB, and -30 dB. Combined, the three attenuators provide 12 steps of attenuation in 10 dB increments from 0 dB to 110 dB.

Main Amplifier

This circuit is a wide-band, non-inverting amplifier having a differential input. It has a high input impedance, low output impedance, and a gain of 20. The output signal level is 20 mV rms for full scale meter deflection.

Output Amplifier

This circuit is also a wide-band, non-inverting amplifier with a differential input. The circuit is compensated for stable operation even with capacitive loads. Gain is 50 times and the output impedance is 600 ohms. The OUTPUT signal level is 1 volt rms at full scale meter deflection.

Absolute Mean Value Detector

This circuit includes a high through-rate, high gain amplifier with differential input. Negative bias voltage is developed from the current flowing through the meter, resulting in very good linearity. The circuit design includes high frequency phase correction to achieve the wide frequency band characteristic. The full wave rectifier diodes convert the applied ac voltage to the corresponding absolute mean value (average value) of the dc current flowing through the meter. However, the gain of the amplifier is adjusted to produce a meter reading corresponding to the rms value of an applied sine wave voltage.

Attenuator Control

This logic circuit is comprised of a diode matrix and output buffer transistors, which ultimately drive the switching relays or FET switches in the three attenuators. The diode matrix encodes a 12-bit signal from the RANGE selector switch to a 6-bit logic signal. This design facilitates remote control range switching. In Dual-Channel Model 297, this design also facilitates the Interlock-Independent range selection feature.

RANGE Selector

The range selector switch is a 12-position rotary switch for selecting the desired voltage range. The outputs of this switch are the 12-bit input to the attenuator control circuit.

Dual Channel Model 297 has two RANGE selectors which may be operated independently, or can be interlocked so that the CH 1 & 2 switch selects the range for both channels.

When the CH 2 SELECTOR switch is set to the Interlock position, the CH 1 & 2 switch feeds both attenuator control circuits. Similarly, when the CH 2 SELECTOR switch is set to Independent, the CH 2 RANGE selector feeds the attenuator control circuit for channel 2 and the CH 1 & 2 RANGE selector feeds only the attenuator control circuit for channel 1.

RELATIVE REFerence Control

This circuit is found only in Single-Channel Model 295. When the RELATIVE REF control is turned fully clockwise to the CAL position, the switch contacts are closed and there is no attenuation between the main amplifier and the absolute mean value detector circuit. Rotating the control counterclockwise away from the CAL position opens the switch contacts and routes the main amplifier output through the RELATIVE REF potentiometer. This attenuates the input to the absolute mean value detector corresponding to the amount of resistance selected by the potentiometer, and can be adjusted for less than full scale meter deflection as a convenient reference point for dB measurements.

For accurate voltage measurements, the RELATIVE REF control must be set to CAL. An UNCAL indicator operates from a second set of switch contacts of the control any time it is rotated away from the CAL position.

GND MODE Switch

This circuit is included only in Dual-Channel Model 297. In this model, the outer conductors of the INPUT jacks are insulated from the case. The GND MODE switch permits these outer conductors to be grounded to the case in the GND position of the switch, or to remain isolated from the case in the OPEN position. This permits floating of the signal reference to a voltage point in the equipment under test. The ground jack on the rear of the instrument is common with the case (and earth ground via the power cord) and should be connected to the chassis of the equipment under test when floating reference measurements are made.

Power Supply

The power supply converts ac line voltage to ±5 volts dc using a full wave diode bridge rectifier, high capacitance electrolytic filter capacitors, and IC regulators for stabilization. The dual, tapped primary windings of the power transformer permit the line voltage selector plug to connect the primary circuit in four configurations for operation from 100, 120, 220, or 240 volts. The +5 volt output of the power supply is applied to the pilot light LED when the unit is operating. One set of contacts of the POWER switch act as the on-off control of primary voltage to the power transformer. The other set shorts the taut-band meter when the unit is off protection against excessive pointer bounce.

Remote Control

The unit may be modified to permit remote control of range switching as shown in Appendix I. The range switching arrangement on the remote control box duplicates that of the front panel. A PANEL-REMOTE switch selects which one of the switching arrangements is enabled.

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CASE REMOVAL

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REPLACING THE

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WARNING

1. *The following instructions are for use by qualified service personnel only. To avoid electrical shock, do not perform servicing other than contained in the operating instructions unless you are qualified to do so.*
2. *A shock hazard is present when the case is removed if the power cord is plugged into an ac outlet. AC line voltage may be present on some circuits even when the POWER switch is off.*

CASE REMOVAL

Refer to Fig. 13. Remove six screws, two from each side and two from the top. Spread the bottom of the sides and pull upward to remove.

REPLACING THE CASE

Refer to Fig. 14. Spread the bottom of the case sides and slide it over the main body of the meter. Align the circuit board retainers with the circuit board. Alternately tighten the six screws for uniform torque - do not overtighten screws, as damage may result.

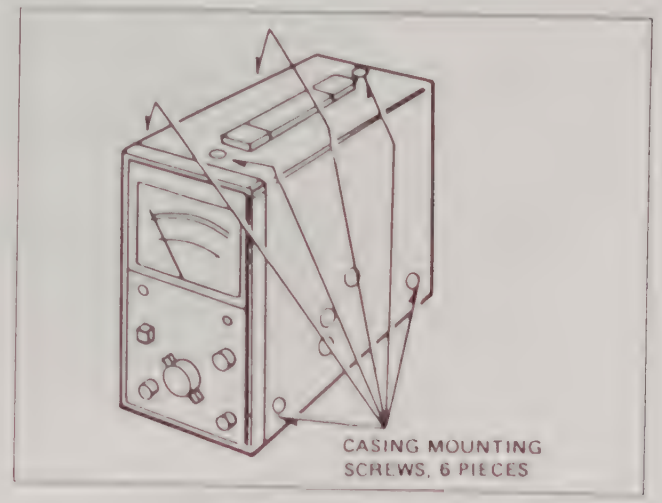

Fig. 13. Case Removal

FUSE REPLACEMENT

The fuseholder is mounted on the rear panel. Remove the fuseholder cap with a Phillips screwdriver and replace the fuse with the correct value as listed on the plate adjacent to the fuseholder.

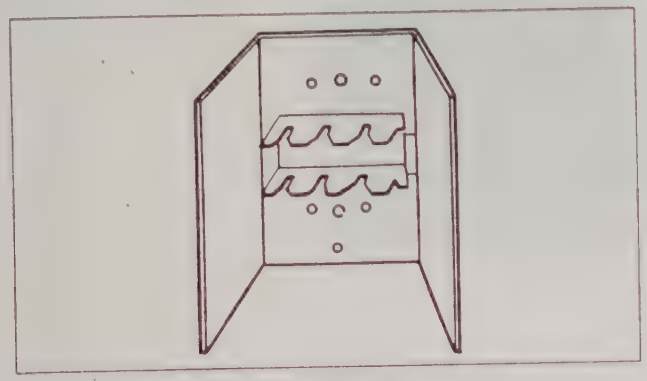

Fig. 14. Circuit Board Retainer.

CALIBRATION

This instrument was carefully checked and calibrated at the factory prior to shipment. Readjustment is recommended only if repairs have been made in a circuit affecting calibration, or if you have reason to believe the unit is out of calibration. Complete calibration procedures are given in this manual. However, calibration adjustments should be attempted only if the proper test equipment is available, and you are experienced and qualified in its use. Refer to Fig. 15 for the location of calibration adjustments. For Model 295, the adjustments are all located on the right side of the case. For Model 297, channel 1 adjustments are located on the left side of the case and channel 2 adjustments are on the right.

Test Equipment Required

AC Voltmeter Calibrator. Accuracy within ±0.1% at 30 mV and 10 volts rms at 1 kHz or 400 Hz.

Wideband Signal Generator. Low distortion sine wave output. Frequency response within ±0.2% from 1 kHz to 50 kHz with respect to 1 kHz reference.

Procedure

1. Before turning the POWER switch ON, adjust the meter zero-adjust screw on the front panel so the pointer correctly indicates "0". For Model 297, the right zero-adjust screw is for channel 2, and the left for channel 1.
2. For Model 297, set the CH 2 SELECTOR to Independent (right). For steps 3 thru 8, all references apply to channel 1 of Model 297.
3. Connect the voltmeter calibrator to the INPUT connector. Set the voltmeter calibrator to 30 mV at 1 kHz or 400 Hz.
4. Set the ac voltmeter to the 30 mV range and adjust VR102 for a meter reading of 3.0 on the 0-3 scale.
5. Set the voltmeter calibrator to 10 V and set the ac voltmeter to the 10 V range. Adjust VR101 for a meter reading of 10.0 on the 0-10 scale.
6. Disconnect the voltmeter calibrator and connect the wideband signal generator. Set the signal generator to 1 kHz.
7. Set the ac voltmeter to the 1 V range and adjust the signal generator level for a 1.0 V meter reading.

Fig. 15. Calibr

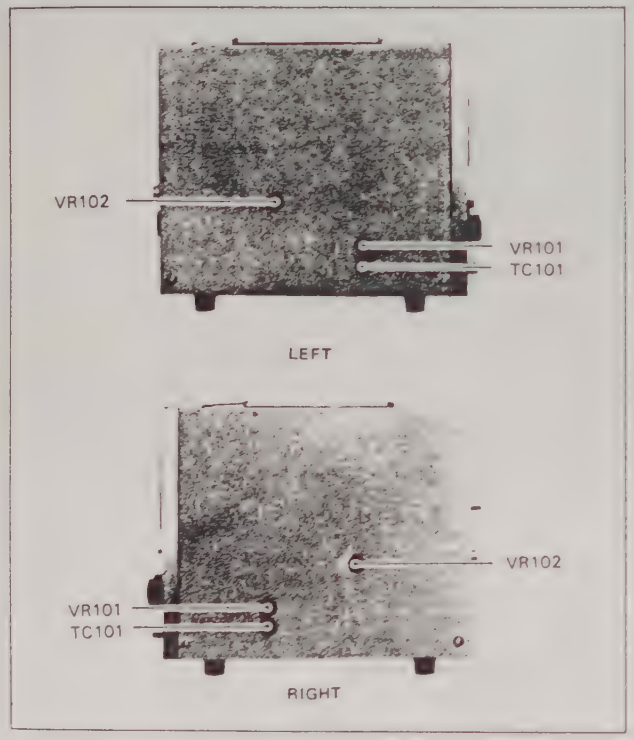

Fig. 15. Calibration Adjustment Locations.

8. Without changing the signal generator level, increase the frequency to 50 kHz. Adjust TC101 for identical reading to that obtained in step 7.
9. Repeat steps 3 thru 8 to eliminate interaction.
10. For Model 297, repeat entire procedure for channel 2.

MODIFICATION FOR REMOTE CONTROL

If the remote control feature is desired, the unit must be modified as shown in Appendix I. Fabricate a remote control box, wired as shown in Appendix I. Connect wiring from the remote control pins of the circuit board(s) to the remote control box. For quick disconnect of the remote control box, a connector may be added behind the rear panel access plate.

INSTRUMENT REPAIR AND CALIBRATION SERVICE

Because of the specialized skill and test equipment needed for instrument repair and calibration, many customers prefer to rely upon B & K-Precision authorized service agencies for this purpose. To use this service, even if your wideband ac voltmeter is no longer under warranty, follow the instructions given in the WARRANTY SERVICE INSTRUCTIONS portion of this manual. There is a nominal charge for instruments out of warranty.

APPENDIX I - REMOTE CONTROL

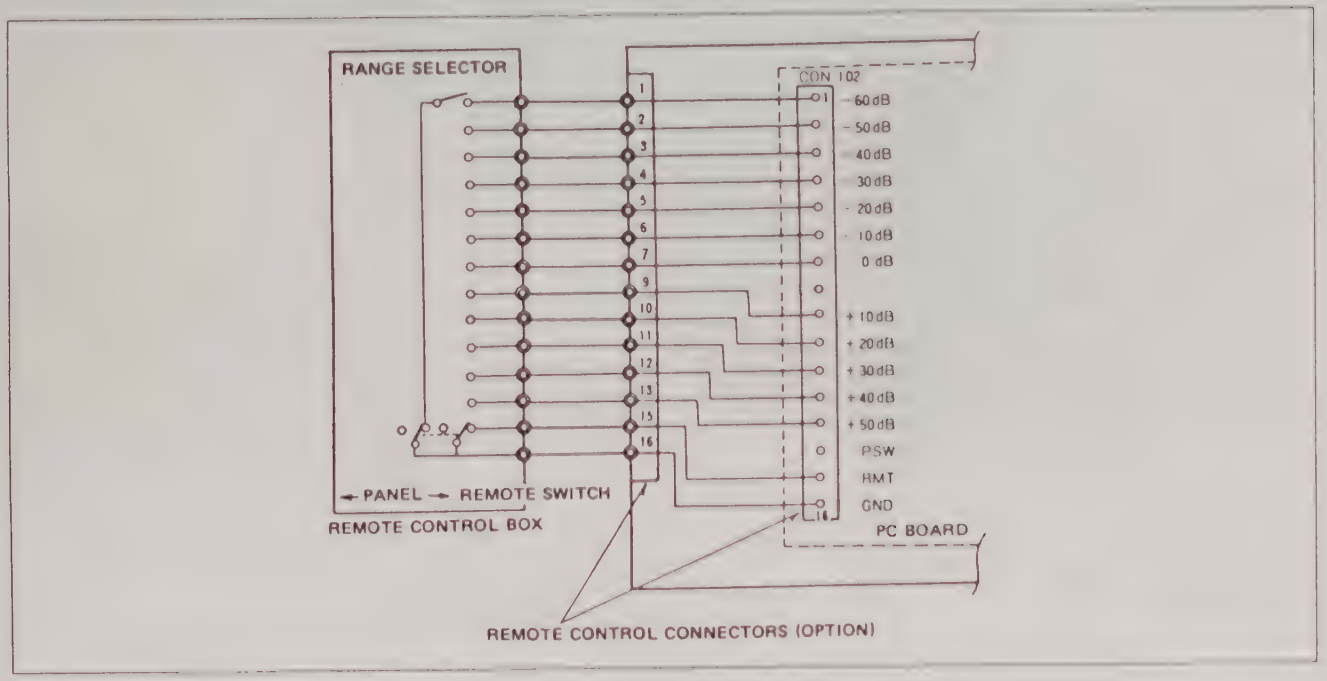

Fig. A1. Remote Control Wiring Diagram, Model 295.

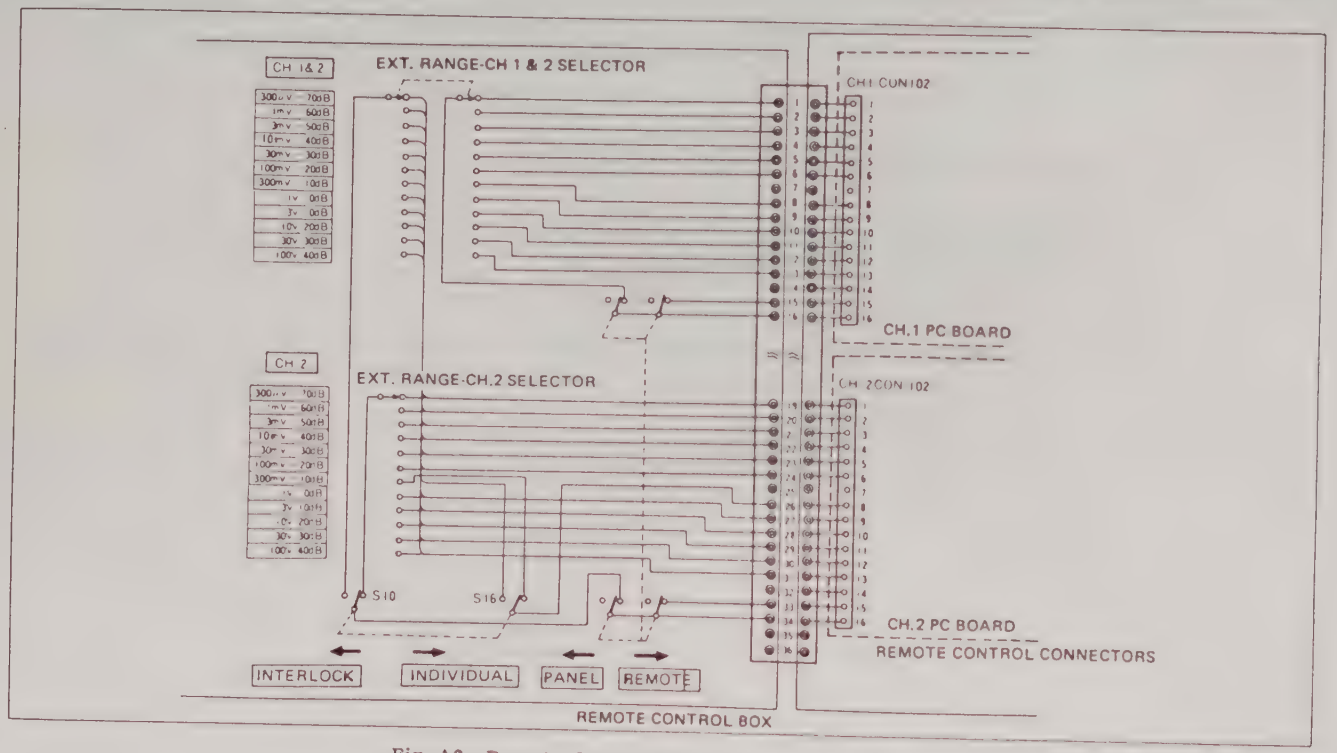

Fig. A2. Remote Control Wiring Diagram, Model 297.

WARRANTY SERVICE INSTRUCTIONS
(For U.S.A. and its Overseas Territories)

1. Refer to the MAINTENANCE section of your **B & K-Precision** instruction manual for adjustments that may be applicable.

2. If the above-mentioned does not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred in U.S.A.) to the nearest **B & K-Precision** authorized service agency (see list enclosed with unit).

If your list of authorized **B & K-Precision** service agencies has been misplaced, contact your distributor for the name of your nearest service agency, or write to:

B & K-Precision, Dynascan Corporation
Factory Service Operations
4050 North Ravenswood Avenue
Chicago, Illinois 60613
Tel (312) 327-7270
Telex: 25-3475

Also use this address for technical inquiries
and replacement parts orders.

LIMITED ONE-YEAR WARRANTY

DYNASCAN CORPORATION warrants to the original purchaser that its **B & K-Precision** product, and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

DYNASCAN will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized **B & K-Precision** service contractor or the factory service department, accompanied by proof of the purchase date in the form of a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing and mailing the enclosed warranty registration card to DYNASCAN, **B & K-Precision**, 6460 West Cortland Street, Chicago, Illinois 60635 within fifteen (15) days from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

DYNASCAN shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your **B & K-Precision** distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to **B & K-Precision** Service Department, 4050 North Ravenswood Avenue, Chicago, Illinois 60613, properly packaged to avoid damage in shipment.

B & K-Precision Test Instruments warrants products sold only in the U.S.A. and its overseas territories. In other countries, each distributor warrants the **B & K-Precision** products which it sells.

B+K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street
Chicago, Illinois 60635

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480-430-9-001

*Decorative Panel, Inlay	260-383-9-001
*Decorative Panel, Inlay	260-384-9-001
Bezel	380-500-9-001
#Bezel	380-500-9-002
*Bezel	380-501-9-001
Handle	746-039-9-001
Leg	381-054-9-001
#Meter	320-126-9-001
*Meter	320-127-9-001
*BNC Receptacle	772-024-9-001
BNC Receptacle, Insulated	772-045-9-001
UL-CSA Power Cord	420-030-9-001
Voltage Selector Plug	770-019-9-002
*Fuse 0.1 Amp, 3AG (220, 240V)	191-003-9-001
*Fuse 0.2 Amp, 3AG (100, 120V)	191-006-9-001
#Fuse 0.3 Amp, 3AG (220, 240V)	191-010-9-001
#Fuse 0.5 Amp, 3AG (100, 120V)	191-251-9-102
Fuse Holder	742-029-9-001
PCB Holder	251-591-9-001
Bracket for Meter	251-592-9-001
Bracket for Switch	251-593-9-001
Knob, RANGE	751-124-9-001
Knob, POWER	751-291-9-001
*Knob, RELATIVE REF	751-292-9-001
Input Cable, BNC to Dual Alligator Clips	534-241-0-000
Instruction Manual	480-430-9-001

NOTE: * = Model 295 only.
= Model 295 only.

PARTS ORDERING INFORMATION

There is a minimum charge for each invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover handling, postage, or express charges. Specify model and serial number when ordering replacement parts.

ORDER REPLACEMENT PARTS FROM:

B & K-Precision, Dynascan Corporation
Factory Service Operations
4050 North Ravenswood Avenue
Chicago, Illinois 60613

B&K PRECISION DYNASCAN CORPORATION
6460 West Cortland Street, Chicago, Illinois 60635

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DIAGRAM AND PARTS LIST

B&K PRECISION **295 297**

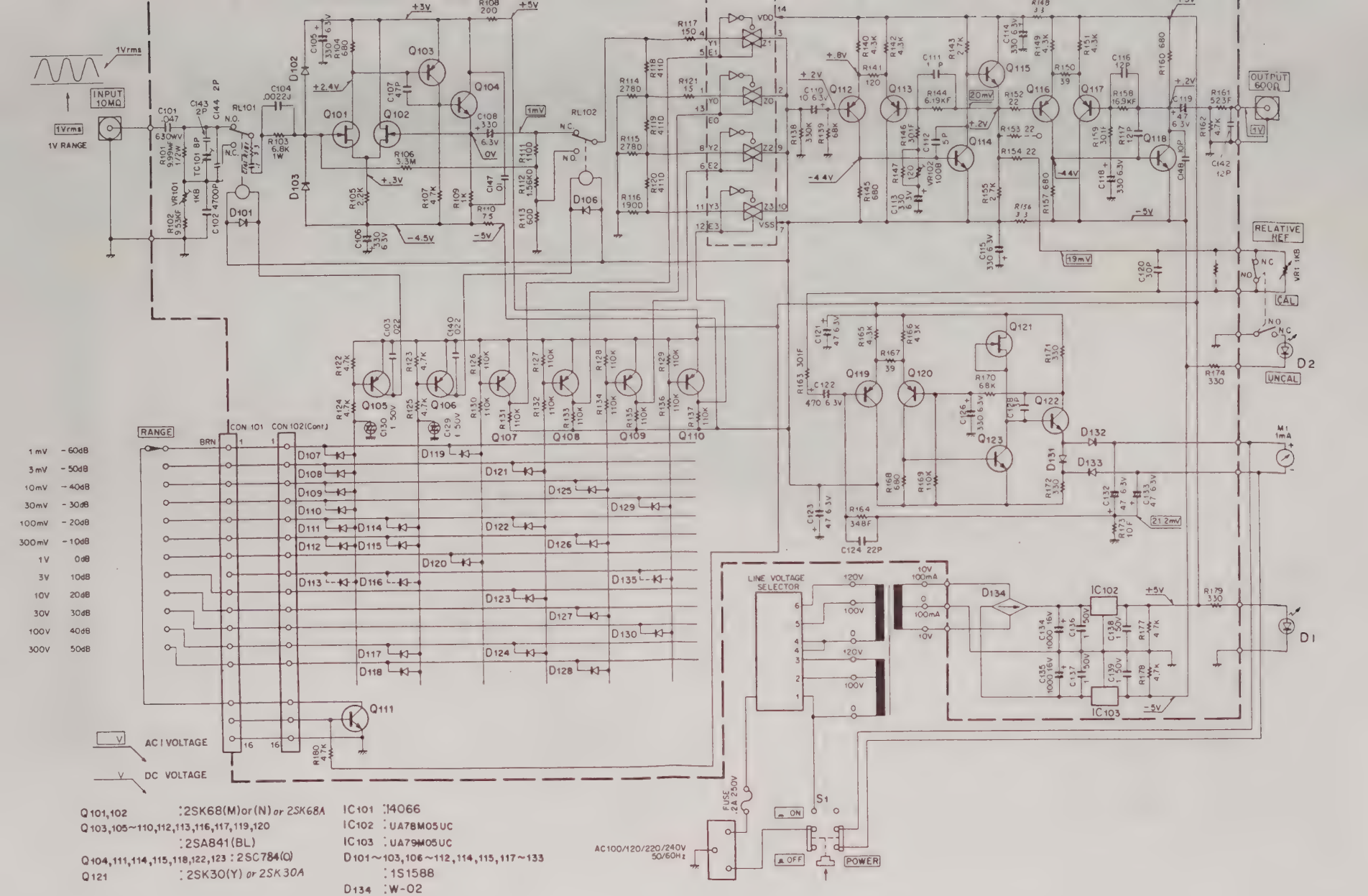
Wide Band AC VOLTMETER

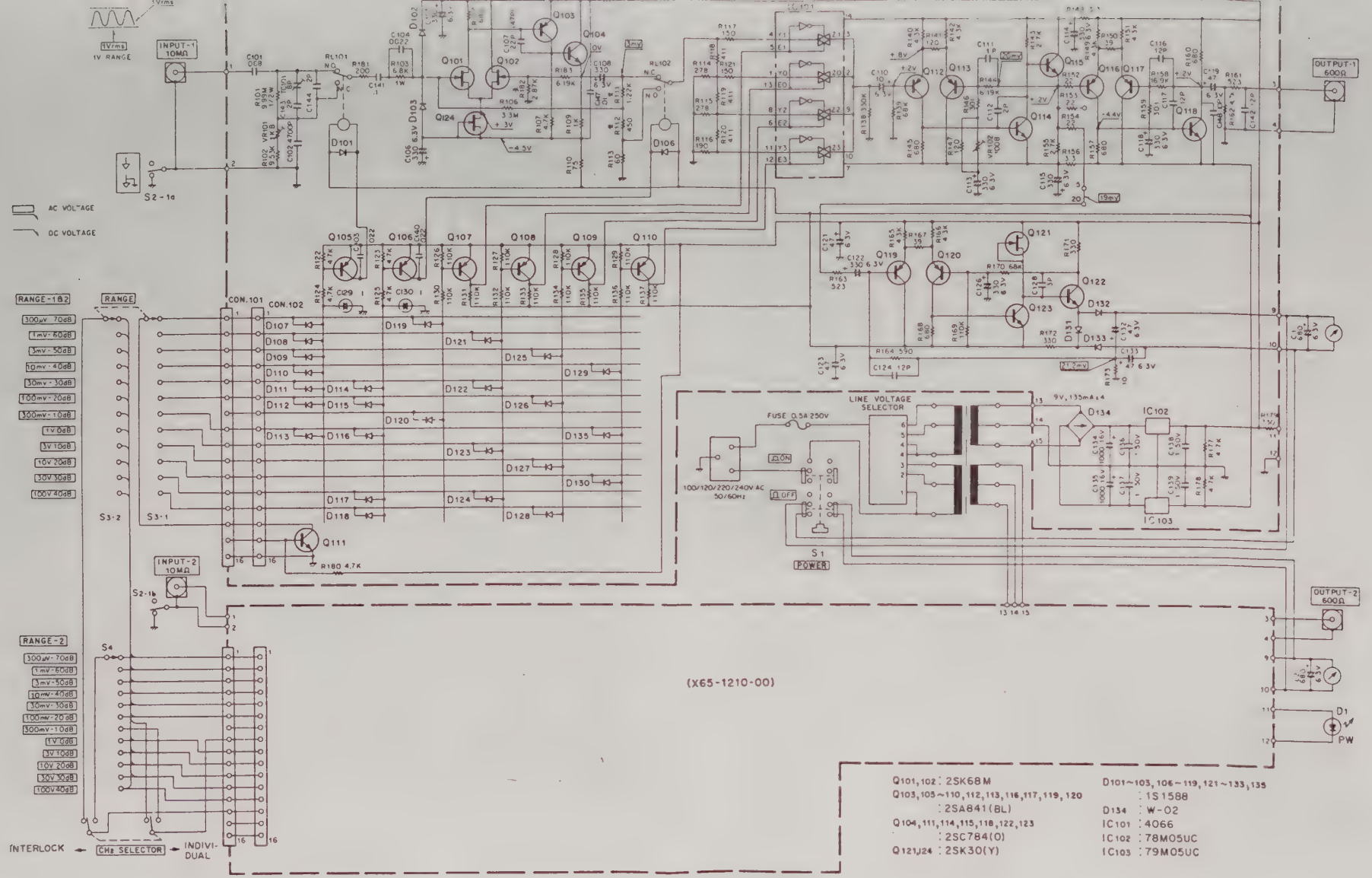
PARTS LIST

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NUMBER
	RESISTORS	
	Unlisted resistors are ±5%, 1/4 W. See schematic diagram for value.	
R101	9.99 MΩ ±1%, 1/2 W Fixed	004-213-9-001
R102	9.53 kΩ ±1%, 1/4 W Metal Film	015-144-9-531
R103	6.8 kΩ ±5%, 1 W Metal Film	011-001-5-682
R111*	110 Ω ±0.5%, 1/4 W Metal Film	013-093-9-001
R111#	1.22 kΩ ±0.5%, Fixed	004-213-9-004
R112	1.56 kΩ ±0.5% Fixed	004-214-9-001
R113	60 Ω ±0.5% Fixed	004-213-9-002
R114, 115	278 Ω ±0.5%, 1/4 W Metal Film	013-092-9-002
R116	190 Ω ±0.5%, 1/4 W Metal Film	013-092-9-001
R118, 119, 120	411 Ω ±0.5%, 1/4 W Metal Film	013-092-9-003
R144, 183#	6.19 kΩ ±1%, 1/4 W Metal Film	015-144-6-191
R146, 159, 163*	301 Ω ±1%, 1/4 W Metal Film	015-144-3-010
R158	16.9 kΩ ±1%, 1/4 W Metal Film	015-144-1-692
R161, 163#	523 Ω ±1%, 1/4 W Metal Film	015-144-5-230
R164*	348 Ω ±1%, 1/4 W Metal Film	015-144-3-480
R164#	590 Ω ±1%, 1/4 W Metal Film	015-144-5-900
R173	10.0 Ω ±1%, 1/4 W Metal Film	015-144-1-008
R182#	2.87 kΩ ±1%, 1/4 W Metal Film	015-144-2-871
VR1	1 kΩ Potentiometer, with Rotary Switch, RELATIVE REF Control	008-491-9-001
VR101	1 kΩ Trimmer Pot	008-155-9-005
VR102	100 Ω Trimmer Pot	008-282-9-004
	CAPACITORS	
C1#, 2#, 3#, 4#	3 µF, 6.3 V Electrolytic	022-287-9-001
C101	0.068 µF, 630 V Metalized Polyester	033-080-9-001
C102	4700 pF ±5%, 50 V Mylar	030-063-9-003
C103*, 109#, 120#, 140*	2200 pF ±20%, 50 V Mylar	030-063-9-002
C104	2200 pF ±5%, 50 V Mylar	030-063-9-001
C105, 106, 108 113, 114, 115, 118, 122#, 126	330 µF, 6.3 V Electrolytic	022-287-9-002

NOTE: * = Model 295 only
= Model 297 only

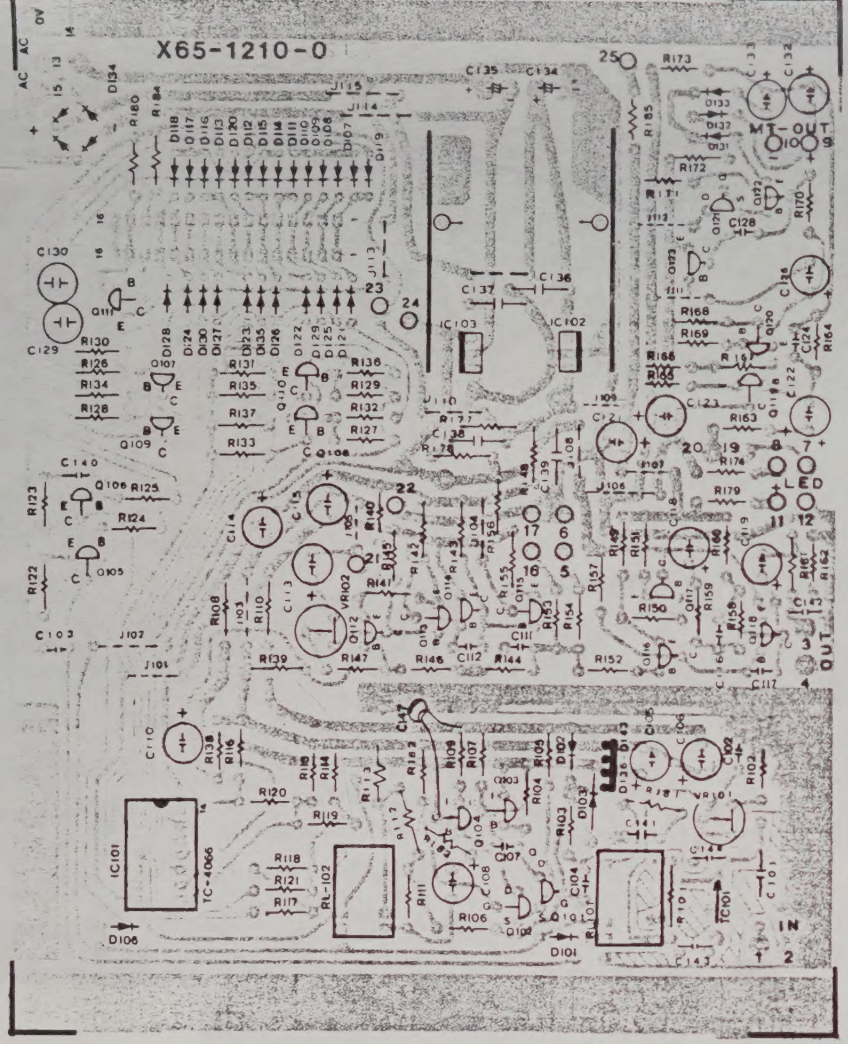
COMPOSITE 499-314-9-001


INPUT 10MΩ
1Vrms
1V RANGE
RANGE
1 mV -60dB
3 mV -50dB
10 mV -40dB
30 mV -30dB
100 mV -20dB
300 mV -10dB
1 V 0dB
3 V 10dB
10 V 20dB
30 V 30dB
100 V 40dB
300 V 50dB
AC VOLTAGE
DC VOLTAGE
LINE VOLTAGE SELECTOR
120V
100V
FUSE 2A 250V
AC100/120/220/240V 50/60Hz
ON
OFF
POWER
S1
OUTPUT 600Ω
RELATIVE REF
CAL
UNCAL
D1
D2
M1 1mA
IC101
IC102
IC103
Q101,102 :2SK68(M)or(N) or 2SK68A
Q103,105~110,112,113,116,117,119,120 :2SA841(BL)
Q104,111,114,115,118,122,123 :2SC784(Q)
Q121 :2SK30(Y) or 2SK30A
IC101 :14066
IC102 :UA78M05UC
IC103 :UA79M05UC
D101~103,106~112,114,115,117~133 :1S1588
D134 :W-02



Q101,102 : 2SK68M
Q103,105~110,112,113,116,117,119,120 : 2SA841(BL)
Q104,111,114,115,118,122,123 : 2SC784(O)
Q121,124 : 2SK30(Y)

D101~103,106~119,121~133,135 : 1S1588
D134 : W-02
IC101 : 4066
IC102 : 78M05UC
IC103 : 79M05UC



C112	2 pF ±0.25 pF, 50 V Ceramic	020-246-9-001
C116, 117, 124#, 142	12 pF ±5%, 50 V Ceramic	020-343-9-001
C119, 121, 123, 132, 133	47 µF, 16 V Electrolytic	022-090-9-003
C122*	470 µF, 6.3 V Electrolytic	022-288-9-001
C128	3 pF ±0.25 pF, 50 V Ceramic	020-112-9-001
C129, 130	1 µF ±20%, 50 V Electrolytic	022-167-9-001
C134, 135	1000 µF ±20%, 16 V Electrolytic	022-287-9-004
C136, 137, 138, 139, 141	0.1 µF, 50 V Ceramic	020-343-9-002
C143, 144	2 pF ±0.25pF, 500 V Ceramic	020-096-9-001
C147	0.01 µF ±10%, 50 V Ceramic	020-296-9-001
C148	10 pF ±0.5pF, 50 V Ceramic	020-142-9-003
TC101*	8 pF Trimmer	028-080-9-001
TC101#	8 pF Trimmer	028-080-9-002

SEMICONDUCTORS

D101 - 133, 135	1S1588 Diode	151-051-9-001
D134	W02 Diode	157-031-9-001
IC101	MC14066BCP IC	307-359-9-001
IC102	UA78M05UC IC	307-359-9-002
IC103	UA79M05AUC IC	307-359-9-003
Q101, 102	2SK68A(M) FET	182-077-9-001
Q103, 105, 106, 107, 108, 109, 110, 112, 113, 116, 117, 119, 120	2SA970(BL) PNP Silicon Transistor	177-073-9-001
Q104, 111, 114, 115, 118, 122, 123	2SC784(0) NPN Silicon Transistor	176-160-9-001
Q121, 124	2SK30A(Y) N-Channel FET	182-051-9-001

SWITCHES

S1#	Push Switch, POWER	088-121-9-001
S1*	Push Switch, POWER	088-122-9-001
S2*	Rotary Switch, RANGE	083-306-9-001
S2#	Slide Switch, GND MODE	084-131-9-001
S3#,4#	Rotary Switch, RANGE	083-305-9-001

MISCELLANEOUS

D1,2	LED Lamp (Red)	400-072-9-001
RL101,102	Relay	441-042-9-001
	#Power Transformer	065-193-9-001
	*Power Transformer	065-194-9-001
	#Case	272-176-9-001
	*Case	272-177-9-001
	#Panel	255-236-9-001
	*Panel	255-237-9-001

NOTE: * = Model 295 only
= Model 297 only

MP MASTER
MA20009

MP MASTER
MA20009